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## NOTES ON THE BREEDING BIOLOGY, HUNTING BEHAVIOR, AND ECOLOGY OF THE TAITA FALCON IN ZIMBABWE

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**ABSTRACT.**—Six pairs of Taita Falcons (*Falco fasciinucha*) were studied during the breeding season from 1989–1991 in four areas of Zimbabwe. Observations during copulation, incubation, provisioning of young, and hunting were made for 136.6 hr; vocalizations and their contexts were also recorded. The males were more strikingly colored than the females. The nests were in cliff holes protected from direct sunlight on cliffs from 15–290 m in height. Incubation started from late August to early September. In nine years eight fledglings were produced, giving a productivity of 0.88 fledglings per reproductive attempt. Three 10 d old chicks were fed every 1.8 hr with feeding sessions averaging 10 min. Taita Falcons employed five hunting methods: still hunting from a high vantage point; speculative hunting; stooping from a high aerial position; aerial hawking of insects, and cooperative hunting. Hunting success was 20.7% where most of the hunting was carried out within 1 km of the nest site. Prey consisted primarily of small- to medium-sized birds with an average weight of 36.4 g; they were caught mainly in woodland and the cliff habitats close to the nest. Food caching occurred at each site. Vocalizations included a raspy “hee-chuck” during mutual interactions; a croaky wail when soliciting food and for less intense interactions; a whining call from the female and a chitter from the male during copulations; a shriek “chew-wee” from the male when he delivered food and the alarm “kek” from either sex when they defended the nest. Although very secretive around their nests, when other raptors and also Trumpeter Hornbills (*Bycanistes bucinator*) ventured within 200 m, the Taita Falcons attacked them vigorously.

Notas sobre la biología reproductiva, conducta de caza y ecología de *Falco fasciinucha* en Zimbabwe

**RESUMEN.**—Seis pares de *Falco fasciinucha* fueron estudiados durante la estación reproductiva de 1989–91 en cuatro áreas de Zimbabwe. Observaciones sobre copulación, incubación, aprovisionamiento de juveniles y caza, se hicieron durante 136.6 hr; las vocalizaciones y su contexto también fueron registradas. Los machos eran llamativamente más coloridos que las hembras. Los nidos se encontraban ubicados en cavidades existentes en riscos y protegidos de los rayos solares directos; la altura de los riscos variaba entre 15 y 290 m. La incubación comenzó dentro de un período de dos semanas entre fines de agosto y comienzos de septiembre. En nueve pares anuales, ocho volantones fueron producidos, dando una productividad de 0.88 volantones por intento reproductivo. Tres polluelos de 10 días comían cada 1.8 hr, en sesiones de 10 min en promedio. *Falco fasciinucha* empleaba cinco métodos de caza: caza silenciosa desde un punto alto y favorable; caza especulativa; inclinado en alerta con una posición de espera; caza aérea de insectos; y caza cooperativa. El éxito de caza en uno de estos sitios fue de 20.7%, donde la mayoría de la caza fue realizada a más de un km del sitio de nidificación. Las presas consistieron principalmente en aves de talla pequeña a mediana con un peso promedio de 36.4 g. Ellas fueron capturadas principalmente en bosques abiertos y en hábitats de riscos cercanos al nido. La captura de presas ocurrió en cada uno de los sitios. Las vocalizaciones incluyeron un sonido raspado “hee-chuck” durante interacciones mutuas; un graznido de lamento cuando se solicita comida y para interacciones menos intensas; un gemido de la hembra y un chillido del macho durante la copula; un chillido “chew-wee” del

macho cuando entregaba comida y uno de alarma "kek" por cada uno de los sexos cuando defendían el nido. Aunque los alrededores del nido eran muy discretos, cuando otras rapaces y también *Bycanistes bucinator* se acercaban a menos de 200 m, *F. fasciinucha* atacaba en forma violenta.

[Traducción de Ivan Lazo]

The Taita Falcon (*Falco fasciinucha*) is a small and rare raptor which has been little studied (Brown et al. 1982, Cade 1982, Steyn 1982). Although less than half the size, it is similar to the African Peregrine Falcon (*Falco peregrinus minor*; Cade 1982) with which it is sympatric (Hunter et al. 1979, Thomsett 1988, Moller 1989, Hustler 1989, Jenkins et al. 1991).

Although aspects of the breeding biology have been studied by Holliday (1965), Colebrook-Robjent (1977) and Dowsett (1983) in Zambia, Hunter et al. (1979) in Malawi and Moller (1989) in Uganda, these amount only to observations on four nest sites. There are few data on laying dates (Brown et al. 1982, Irwin 1981, Steyn 1982, Maclean 1985), hunting behavior and specific prey species, especially in southern Africa. Our study includes information on nest site characteristics, copulation, laying dates, provisioning of young, productivity, hunting, prey, vocalizations and their contexts, and interspecific behavior of six pairs obtained during different parts of the breeding cycle.

#### STUDY AREA

The study was conducted in the Middle Zambezi Valley and in the Eastern Highlands of Zimbabwe. All of the nests were located in zones of dry deciduous woodland with a mean annual rainfall of 400–712 mm falling between November and March (Dept. Meteorological Services 1977). The maximum mean monthly temperatures were 32–36°C in October and the mean annual temperature range was 9°C (Torrance 1965). The altitude of nests ranged from 460–1050 m.

The scree slopes below the basaltic nesting cliffs were covered with mixed deciduous woodland and grassland. Riverine thickets and forest extended along sections of the Zambezi River and its tributaries that contained permanent pools. The plateau is at 880 m and was covered by mopane (*Colophospermum mopane*) woodland. The hillslopes at one site were covered with miombo woodland (dominated by *Brachystegia glaucescens*) and the sandstone plateau (1050 m) by *B. boehmii* and *Julbernardia globiflora* woodland. The riparian forest was characterized by *Combretum* sp. thicket, *Trichelia emetica*, *Diospyrus mespiliformis* and *Tamarindus indica*. The lower-lying areas consisted of undulating to rugged terrain with a variety of habitat from mixed deciduous woodland dominated by *Brachystegia* sp. on the sandstone hilltops and scree slopes to a mixture of riverine bush and grassland near the streams and stands of *C. mopane* woodland along the interflaves.

#### METHODS

The sites were studied by teams of two or more observers, each using 10 × 40 binoculars and a 20× spotting scope in 1990 and 1991. Nests were designated as N1–N6.

Productivity was based on all chicks seen including four that were 10–23 d old taken for a captive breeding program. Age of young and estimated commencement of incubation were based on 31–33 d incubation and 42 d fledging age (Moller 1989, pers. obs.). Incubation normally starts with the second or penultimate egg and eggs are normally laid 2–4 d apart (Dowsett 1983).

A total of 136.6 hr of observation were carried out at all sites combined. As the falcons are most active from dawn until mid-morning and then again after mid- to late-afternoon (Moller 1989, pers. obs.), observation times were often coordinated to fit into this regime, except for two dawn-to-dusk watches at two nests when the chicks were 10 d old, and had fledged young, respectively. Visits were made from August–December.

A foray was defined as a flight in which prey capture appeared to be the main objective and it may have included any number of capture attempts. A stoop was any kind of dive during a hunting foray that appeared to be directed toward a prey item. A chase was a direct flapping flight at a prey item.

Prey was identified from pluckings, remains (particularly feet and beaks), and pellets collected from nests and from observations at all sites.

#### RESULTS

**Plumage of Adults.** At all sites except N5 the adult male was a rich cinnamon, almost a peachy hue on the chest (see photo in Hartley 1991). This male's crop bore brighter cream-colored feathers with its normal cinnamon wash as well. His nape patches, fringes of the malar stripes, and auricular area were a matching rich cinnamon, contrasting with his cream-colored cheeks and black helmet.

By contrast the female was a duller, more pastel hue, her chest flanks and flags more heavily streaked with dark brown than the male's, which appeared almost unmarked. The nape and upper back areas were dark on both sexes, contrasting with the lower wing coverts, scapulars and rump which were a lighter grey.

At N5 both adults were very pale colored on the chest, tending to buff, but again the male had a slightly richer hue than the female (see also Holliday 1965, Dowsett 1983, Moller 1989).

**Nest Sites.** Four of the sites were on high cliffs, and three (Table 1) were on very low cliffs, all near permanent water. N1–N3 were located in convoluted gorges. N4b and N5 were on mesas overlooking dry streambeds with occasional pools of permanent water. N4a was in a small gorge system. N6 was on a mesa some 600 m above a perennial river.

Table 1. Nest site characteristics of Taita Falcons in Zimbabwe. (Distance to top is the distance from the nest to the top of the nesting cliff. Cliff ratio is the relative distance of the nest from the bottom of the nesting cliff.)

SITE <sup>a</sup>	ROCK	CLIFF HEIGHT (m)	DIS-TANCE TO TOP (m)	CLIFF RATIO	ASPECT	HEIGHT ABOVE VALLEY (m)	DIS-TANCE TO WATER (km)	NEST DIMENSIONS (cm) <sup>b</sup>			
								W	H	D	O
N1 (H-G)	basalt	135	20	0.85	NNE	140	0.15	50	30	85	0
N1 (L-G)	basalt	135	25	0.81	NNE	140	0.15	—	—	—	—
N2 (H-G)	basalt	57	10	0.82	NNW	150	0.16	100	46	60	200
N3 (H-G)	sandstone	290	66	0.77	WNW	295	0.24	—	—	—	—
N4a (H?-G)	sandstone	15	?	?	N/S?	27	0.20	—	—	—	—
N4b (H?-M)	sandstone	22	?	?	SW	30	1.00	—	—	—	—
N5 (H-M)	sandstone	22	9	0.59	E	45	1.00	85	92	83	0
N6 (H-M)	dolerite	140	40	0.71	SW	420	3.00	70	30	50	175
Mean		97	22	0.78		156	0.74	76	50	70	75

<sup>a</sup> H = hole; L = ledge; G = gorge; M = mesa; ? = suspected nest.

<sup>b</sup> W = width; H = height; D = depth; O = overhang.

At N6 the pair used a White-necked Raven (*Corvus albicollis*) nest, which had probably been used by the ravens the previous year. This is the first time that Taita Falcons have been recorded as using an old stick nest.

Nests did not face due west and thus partially avoided the full extent of the afternoon sun. Although N3 had an unfavorable aspect, the opposite side of the gorge shaded the cliff from 1600 H. Cliff holes were therefore protected for most of the day, while the ledge used at N3 in 1988 was shaded behind a Black Eagle (*Aquila verreauxii*) nest (Hartley and Mundy 1990). Also on a west facing cliff the nest slit of N6 faced south-southwest. The narrowness of the opening minimized penetration by the afternoon sun as well.

**Copulation and Egg Laying.** Copulations took place mainly in the morning (80.0%,  $N = 24$ ) from 0617–1007 H, with 20.0% ( $N = 6$ ) being seen from 1517–1748 H. Fourteen copulations took place in 3.8 hr during a dawn to mid-morning watch on 2 September. Copulations lasted from 5–8 sec, much shorter than recorded by Holliday (1965) and Colebrook-Robjent (1977) and the shortest interval between them was 30 sec. Copulations took place on favorite perch points within 100 m of the nest, including ledges ( $N = 16$ ) and trees ( $N = 14$ ) also used for plucking and eating.

Copulations were not preceded with any discernible courtship behavior; however, on three occasions the female bowed perceptibly, possibly an invitation for copulation. Once copulation followed a territorial defense (also see Moller 1989) by the male against a

Black Eagle. Copulation also occurred while the female was feeding (also see Holliday 1965). In each case the male flew to the female.

Four eggs were laid at N2 and at least two eggs at each of N1 and N5. One broken egg at N5 was addled. One addled egg from N1 weighed 16.3 g and measured  $38.52 \times 31.94$  mm, smaller than eggs in two clutches in Steyn (1982) and 13 eggs ( $\bar{x} = 45 \times 34$  mm) laid by captive Taita Falcons at The Peregrine Fund. The freshly laid eggs at N2 were richly marked with red brown, particularly the first egg.

At N2 the first egg was seen on 31 August. There were 30 bouts of copulation during 22.3 hr observation over 4 d, during which time a second egg was laid on the night of 2 September. The first egg was attended by both birds, particularly the female who turned it and maintained the scrape. She was also standing over it by the time it was nearly dark. Once the second egg was laid she spent 50.2% of the 5.2 hr observed either sitting or standing over them.

**Incubation.** During 10.3 hr observation at N2 on 5–6 October, close to the hatching date, the female incubated for 78.1%, the male for 18.3%, and the eggs were unattended for 3.6% of the time. The male's shifts varied from 8–36 min and averaged 23 min. The female was seen on the eggs at dusk and presumably incubated at night. Commencement of incubation was about 24 August for N1, 5 September for N2, 9 September for N5 and 12 September for N3.

**Productivity.** A total of eight fledglings were produced in nine pair years, yielding 0.88 fledglings per



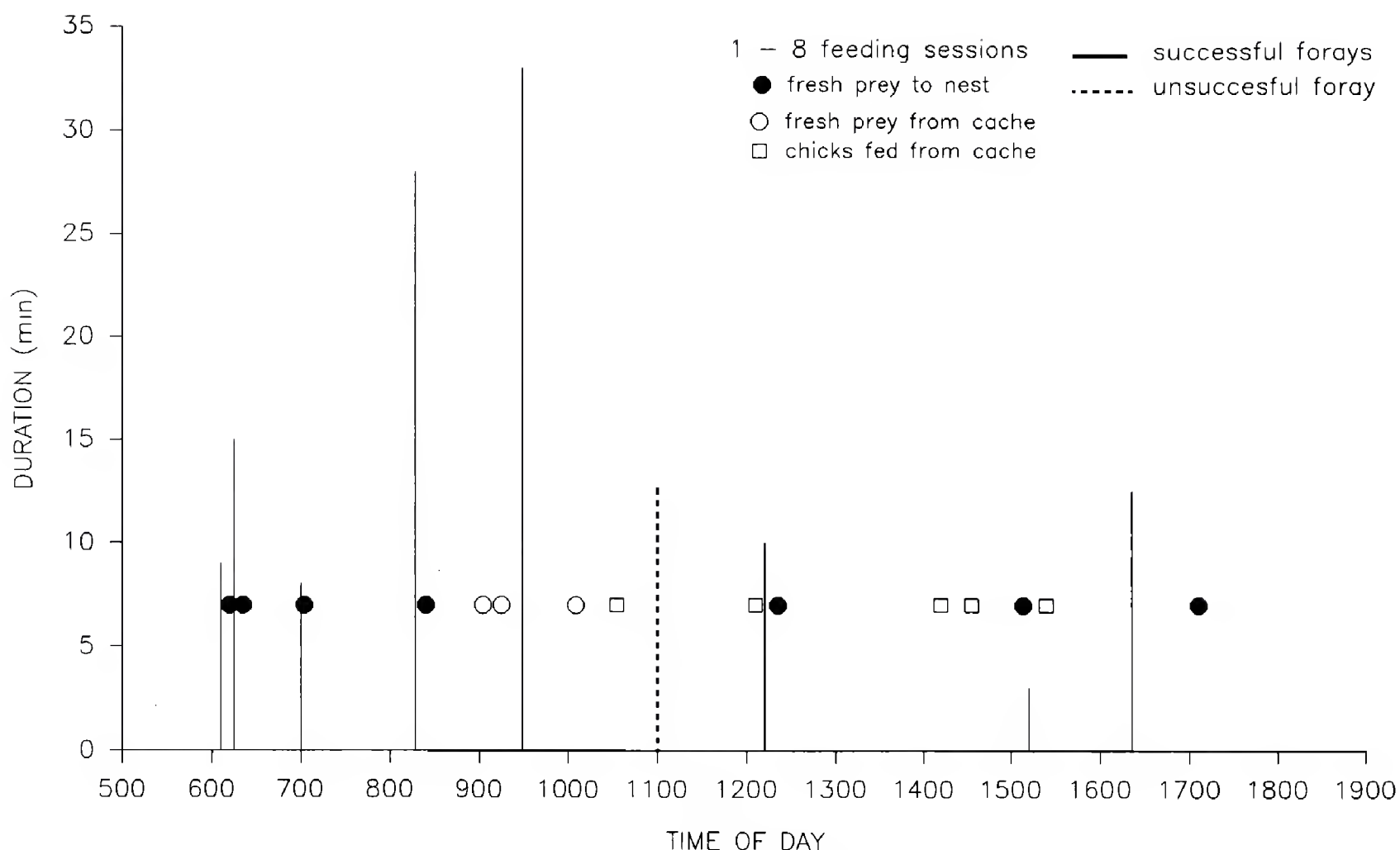


Figure 1. Timing, frequency, and duration of hunting forays for 1 d at N2 when the chicks were about 10 d old.

reproductive attempt. No young were produced at the two southwest facing sites, which also experienced the hottest afternoon temperatures.

**Prey Deliveries.** During courtship at N2, the male was seen to deliver nine birds to the female. Freshly killed birds were delivered unplucked, while those from food caches were either partially or mainly plucked. While it was clear that some of these had their heads removed, insufficient attention was paid to this aspect. Only three prey items were taken by the female, despite the fact that four were delivered to her in the nest. Twice the male left the nest with the prey when the female approached him, once leading to an aerial prey exchange nearby. Twice she took the prey from him at a tree perch. She also retrieved a carcass from a cache.

During the dawn-to-dusk watch at N2 the male provided 10 birds, 70% of these by 1015 H (Fig. 1). Three birds were cached, two after deliveries to the nest had not been taken by the female. The female brought food to the nest three times: twice from a cache and once from a food exchange with the male away from the nest. Twice the male fed the chicks, with the female (perched 0.3 m away) taking over on one oc-

casional. Food was provided at an average interval of 1.8 hr and the sessions lasted an average of 10 min (SD = 4.33,  $N = 8$ ). Three Red-billed Queleas (*Quelea quelea*) were brought in succession, one of them still alive. The other prey consisted of similar-sized birds which were estimated to weigh about 20–30 g each.

**Hunting and Prey.** Five methods of hunting were observed. Still hunting (28.1%;  $N = 18$ ) from a high vantage perch (also see Moller 1989) involved the bird chasing prey directly, either in a stoop or in direct pursuit, the follow-chase described by Meinertzhagen (1959). Speculative hunting (31.3%;  $N = 20$ ) while quartering the cliff top or flying directly over an area involved either a brisk flight along the side of the cliff just below the summit, or a direct flight over an area before looping back to the cliff. Sometimes the bird used the updraft against the cliff to soar, otherwise it stooped or pursued quarry directly. Stooping from a high aerial position (35.9%;  $N = 23$ ; also see Madge 1971, Dowsett 1983, Moller 1989) took place after the bird first climbed to a height of about 200–300 m where it circled in anticipation of finding prey. Cooperative hunting (10.9%;  $N = 7$ ) took place when the pair of adults flew out together and attacked quarry as a team,

stooping one behind the other. Finally, Taita Falcons hawked insects (4.7%;  $N = 3$ ), usually aloft while soaring (also see Hunter et al. 1979). Twenty-one percent ( $N = 29$ ) of individual stoops and chases were successful; seven successful attempts were launched from the cliff and were concluded in less than a minute, and 71.4% of forays were successful ( $N = 32$ ).

At two gorge sites the males spent an average of 11.7 min ( $SD = 7.96$ ;  $N = 41$ ) per hunting foray and the females just 2.4 min ( $SD = 3.22$ ;  $N = 23$ ). The females hunted mainly in front of the cliff and remained nearby, presumably to defend it.

Most of the observed hunting was carried out within 1 km of the nest at N2 and N3 (see Hunter et al. 1979, Moller 1989). At N2 the birds were not seen to pass an observer located just over 1 km upstream. The male was seen heading in this direction up the gorge on 90.6% ( $N = 29$ ) of the observations.

Most of the prey captured were birds less than 50 g in mass (83.2%;  $N = 79$ ), birds from 51–140 g (10.5%;  $N = 10$ ), and insects (11.1%;  $N = 6$ ; Table 2). These were derived mainly from the woodland (55.6% by number and 42.2% by weight;  $N = 30$ ) and cliff habitats (29.6% by number and 54.9% by weight;  $N = 16$ ) with an average weight of 36.4 g ( $N = 48$ ).

Although both male and female Taita Falcons stooped at Trumpeter Hornbills (*Bycanistes bucinator*) these were regarded as interspecific aggressive encounters; the falcons gave the antagonistic “kek-kek” vocalization, driving off the hornbills with a series of powerful stoops. The same may have applied in the case of a stoop at a Rock Pigeon (*Columba guinea*), although no vocalizations were made. Rock Pigeons (347 g; Maclean 1985) breed in holes and on ledges on cliffs and may compete with the Taita Falcons for some of these spots. However, both the Purple-crested Lourie (*Gallirex porphyreolophus*) and the Green Pigeon (*Treron australis*) are similar in size to the Rock Pigeon and were taken as prey.

**Food Caching.** This was a feature at each site during each phase of the breeding cycle, and was most frequent during the nestling period. Caching permitted the falcons to make the best possible use of optimum hunting times and gather extra food for storage (Fig. 1). Cached food ensured that a steady supply was delivered during the nestling period when larger amounts of food are necessary for the chicks.

**Vocalizations.** When at close quarters such as in the nest both birds uttered a slow deliberate and raspy “hee-chuck” call, usually accompanied by the head-low bow posture typical of peregrine and other large falcons

(Cade 1982). Each time the male arrived with food he uttered a croaky wail. Sometimes the female responded with the same call. This call was also used by dependent young that were begging for food. When perched in a tree with prey the male sometimes uttered a harsh bisyllabic shriek “chew-wee,” like a parrot. All copulations were accompanied by a whining call uttered by the female, the faint chitter call of the male could be heard only when the observer was nearby. Occasionally a series of “eechip” calls was heard at the end of a session. Other vocalizations included softer solicitation calls of “kree kree” from the chicks in the nest, some croaky “hee-chips” from the male when he fed chicks in the nest and the usual falcon “kek kek” from both adults when they defended the territory.

**Interspecific Behavior.** The Taita Falcons defended their nests vigorously against other raptors, particularly Black Eagle, Augur Buzzard (*Buteo rufofuscus*), Brown Snake Eagle (*Circaetus cinereus*) and Black Kite (*Milvus migrans*). They also chased peregrines, African Fish Eagle (*Haliaeetus vocifer*), African Hawk-eagle (*Hieraaetus fasciatus*), Common Buzzard (*Buteo buteo*), African Goshawk (*Accipiter tachiro*), Trumpeter Hornbill, and Broad-billed Roller (*Eurystomus glaucurus*). These were driven off with powerful aerial displays, and the Taita Falcons sometimes made contact with the intruders after stooping. An Augur Buzzard and a Brown Snake Eagle were grounded by attacking Taita Falcons.

Most flights were initiated once the intruder was within 200 m of the nest, at cliff top height or below. However, an African Hawk Eagle was chased at a distance of 800 m. High-flying intruders were ignored and the Taita Falcons did not chase intruders that appeared to pose no potential threat to the nest such as a Black Eagle carrying prey. Once the Taita Falcons had young the intensity of territorial defense increased markedly. Both adults engaged intruders, either individually or cooperatively.

Peregrine Falcons were not always attacked. Once a female Taita Falcon continued hunting above a circling peregrine within 500 m of an occupied Taita Falcon site with fledged young. At one gorge site located 300 m from an occupied peregrine site, the Taita Falcons generally avoided the peregrine site. However, once when an adult Taita Falcon initiated an encounter with four recently fledged peregrines, the peregrines were able to drive the Taita Falcon away.

Attacks against Trumpeter Hornbills suggest that the hornbills may prey upon eggs and nestlings. This is supported by observations on captive hornbills (A.

Table 2. Prey remains (A), prey captured (B), and prey pursued (C) by Taita Falcons at six sites in Zimbabwe. Prey items from published literature sources are included. All weights from Maclean (1985), except Red-winged Starling (Jackson 1988), Green Pigeon (Hartley and Mundy in press) and Rock Pratincole (Natural History Museum, Bulawayo). Cl = cliff; W = woodland; O = other.

SPECIES	HABI-TAT <sup>a</sup>	NUMBER TAKEN				MASS (g)	REFERENCE <sup>b</sup>
		A	B	C	TOTAL		
<b>Birds</b>		(38)	(38)	(13)	(89)		
Black Swift ( <i>Apus barbatus</i> )	Cl	1	2		3	42.9	1
Unidentified swifts ( <i>Apus</i> sp.)	Cl					10-88	2
Unidentified swallows ( <i>Hirundo</i> sp.)	Cl					7-43	2
Lesser Striped Swallow ( <i>Hirundo abyssinica</i> )	Cl					17.0	3
Rock Martin ( <i>Hirundo fuligula</i> )	Cl	1	1	6	8	22.4	1, 4
Unidentified martins ( <i>Hirundo</i> sp.)	Cl					16-30	2
Red-winged Starling ( <i>Onychognathus morio</i> )	Cl			5	5	130.3	1, 5
Green Pigeon ( <i>Treron australis</i> )	W					271.0	2
Green-spotted Dove ( <i>Turtur chalcospilos</i> )	W		1		1	63.5	2
Purple-crested Lourie ( <i>Gallirex porphyreolophus</i> )	W					278.0	5
Black Cuckoo Shrike ( <i>Campephaga flava</i> )	W	1			1	33.0	1
Black-eyed Bulbul ( <i>Pycnonotus barbatus</i> )	W	2			2	38.9	2, 6, 7, 8
Yellow-bellied Bulbul ( <i>Chlorocichla flaviventris</i> )	W		1		1	43.0	1
Miombo Rock Thrush ( <i>Monticola angolensis</i> )	W	1			1	44.7	1, 3
Familiar Chat ( <i>Cercomela familiaris</i> )	W	2			2	20.8	1
Mocking Chat ( <i>Thamnolaea cinnamomeiventris</i> )	W	1			1	47.7	1
Green-capped Eremomela ( <i>Eremomela scotops</i> )	W		1		1	9.2	1
Black Flycatcher ( <i>Melaenornis pammelaina</i> )	W	1			1	31.5	1
Chin-spotted Batis ( <i>Batis molitor</i> )	W	2			2	11.0	1
Scarlet-chested Sunbird ( <i>Nectarinia senegalensis</i> )	W	1			1	15.0	1
Rattling Cisticola ( <i>Cisticola chiniana</i> )	W					17.9	9
Unidentified weavers ( <i>Ploceus</i> sp.)	W	3			3	20-40	1, 2
Red-billed Quelea ( <i>Quelea quelea</i> )	W	4	3		7	19.5	1, 10, 11

Table 2. Continued.

SPECIES	HABI-TAT <sup>a</sup>	NUMBER TAKEN			TOTAL	MASS (g)	REFERENCE <sup>b</sup>
		A	B	C			
Blue Waxbill ( <i>Uraeginthus angolensis</i> )	W	1			1	10.4	1
Unidentified widowfinches ( <i>Vidua</i> sp.)	W	2			2	12-14	1
Unidentified canaries ( <i>Serinus</i> sp.)	W	2			2	12-14	1
Golden-breasted Bunting ( <i>Emberiza flaviventris</i> )	W		1		1	19.4	1
Rock Pratincole ( <i>Glareola nuchalis</i> )	O					53.0	4
Richard's Pipit ( <i>Anthus novaeseelandiae</i> )	O	1			1	24.1	1
<i>Anthus</i> sp.	O					25.0	12
Red-capped Lark ( <i>Calandrella cinerea</i> )	O	1			1	25.9	1
Unidentified small to medium-sized birds		11	28	2	41	10-50	1, 4, 7
Insects		(6)			(6)		
Dung beetle ( <i>Aphodius</i> spp.)		2			2		1
Wasp (Hymenoptera sp.)		1			1		1
Locusts/large grasshoppers (Orthoptera)		3			3		1
Butterflies (Lepidoptera)							13
Total prey		44	38	13	95		

<sup>a</sup> Cl = cliff; W = woodland; O = other.

<sup>b</sup> Data sources are: 1 = this study, 2 = Moller 1989, 3 = Hartley and Mundy 1990, 4 = Dowsett 1983, 5 = Woodall 1971, 6 = Benson and Smithers 1958, 7 = Holliday 1965, 8 = Black 1983, 9 = Brooke and Howells 1971, 10 = Madge 1971, 11 = Dowsett 1977, 12 = Benson 1961, 13 = Hunter et al. 1979.

Dare pers. comm.). Broad-billed Rollers are known to be aggressive toward other birds, especially raptors (Dean 1989), and so it is likely that the attacks by the Taita Falcons were aggressive rather than predatory.

#### DISCUSSION

This is the first time that Taita Falcons have been confirmed breeding in northern Zimbabwe, although breeding has been suspected (Irwin 1981). Taita Falcons have been found breeding on small granite inselbergs in Malawi and Zambia by Hunter et al. (1979) and J.D. Weaver (unpubl.), respectively. Black (1983) reported a 15 m southwest-facing sandstone cliff, where breeding had been recorded for 3 yr by D. Cumming (in Hustler 1989) and also in 1978 and 1979 (K.

Worsley and G. Sharp pers. comm.). This site was similar to N4, a nest hole 1 m below the summit. Cliff hole sites are normal (Colebrook-Robjent 1977, Moller 1989), although sheltered ledges have been recorded as well (Benson and Smithers 1958, Hartley and Mundy 1990, Jenkins et al. 1991, J.D. Weaver unpubl.) and in this respect the Taita Falcon most likely competes with the Peregrine Falcon (Thomson 1984, Moller 1989, Hustler 1989, pers. obs.), *contra* the report in Dowsett (1983).

The laying period is in accordance with other published accounts for the Taita Falcon in southern Africa, namely Colebrook-Robjent (1973) with two for September, Dowsett (1983) with one for August-September and Jenkins et al. (1991) with one for September.



While Hunter et al. (1979) estimated correctly that a pair in Malawi laid at the end of August contrary to the skepticism of Dowsett (1983), the two July dates given by Benson et al. (1971) either appear to have been incorrectly assigned or the original sources are lacking, based as they were on Benson and Smithers (1958) and Holliday (1965). Together with the five records supplied in this account, plus another five from R.R. Hartley (unpubl.), dates are summarized as one for late August, one for August–September, 14 for September, and one for October.

Timing of laying may be due to the presence of peregrines, always found breeding nearby. In this study Taita Falcons laid, on average, 21 d later (range 13–32 d,  $N = 5$ ) than peregrines nesting in the same vicinity. The peregrine is some 60% larger and the presence of Peregrine Falcons may explain why Taita Falcons are more discreet around the nest, especially during courtship. Consequently, Taita Falcons may lay shortly after the peregrines to avoid any contact when the peregrines are displaying. Peregrines are aggressive around the nest at this time and they will hunt smaller raptors (pers. obs.). The Taita Falcons then intensify their breeding activity when the peregrines are incubating, a period when the latter are also discreet and unobtrusive.

At Mt. Elgon (Moller 1989) and in two intensively surveyed areas of Zimbabwe, Taita Falcons were outnumbered by peregrines, the latter tending to occupy the more dominant cliffs. In Zimbabwe peregrines used cliffs with a more extensive outlook (pers. obs.). For example, at N3 peregrines nested at the outlets of the gorge, while at N4 and N5 they were on the highest outliers. Also peregrines mainly chose the more shaded south-facing slopes (pers. obs.), while the Taita Falcons sometimes were left to accept faces with a less favorable westerly aspect. This accords with Moller (1989), Hustler (1989) and J.D. Weaver (unpubl.) who concluded also that Taita Falcons have been forced to accept less favorable nest sites.

Utilization of a small home range (Hunter et al. 1979) may be also a factor influencing the Taita Falcon's relative rarity compared with the peregrine. By contrast, the peregrine uses a much larger home range—up to 12 km from the nest site (pers. obs.), and it can take a much wider range of avian prey (Mendelsohn 1988, pers. obs.). Prey overlap between the two falcons includes swifts (*Apus* sp.), swallows and martins (*Hirundo* sp.; Hustler 1989, pers. obs.), Green Pigeons, Red-winged Starlings (*Onychognathus morio*), Green-spotted Doves (*Turtur chalcospilos*) and Red-billed Que-

leas (pers. obs.). Both Taita and Peregrine Falcons employ similar methods of hunting and potentially all of the prey taken by the Taita can be taken by the peregrine. Consequently there must be some competition for prey (Hustler 1989) *contra* Moller (1989). Despite these constraints, the proximity of breeding peregrines 300 m away did not appear to have affected the success of the Taita Falcons at N1, contrary to the suggestion of Hustler (1989).

Productivity was low for a species of this size, comparing unfavorably with 1.63 young fledged per site ( $N = 8$ ) by the peregrines found in the same zones over the same period (R.R. Hartley unpubl.). Although the Taita Falcons appeared to have no difficulty in obtaining prey at the gorge sites, it is possible that the other sites were not as well provisioned, while two of these with an adverse aspect did not produce young.

Prey size accords with Dowsett (1983) and Moller (1989) for birds and with Hunter et al. (1979) for insects, and the taking of larger prey (above 50 g) must be regarded as unusual (Dowsett 1983). It is not inconceivable, however, for a Taita Falcon to kill prey slightly larger than itself such as a Green Pigeon or Purple-crested Lourie. However, Mathews (1986) presented a questionable record of a young Helmeted Guineafowl (*Numida meleagris*) being carried by a Taita Falcon. This may have resulted from the misidentification of a juvenile female peregrine as a Taita Falcon. Even a large Taita female (346 g; Hartley and Heinrich 1991) would find it impossible to carry a juvenile guinea fowl. By contrast female peregrines weigh 650 to 800 g (pers. obs.) and have taken male Swainson's Francolin (*Francolinus swainsonii*; Hustler 1983) and guinea fowl (R.R. Hartley unpubl.). Meinerzhagen (1959) recorded a juvenile Taita Falcon (confirmed by Benson [1960]) chasing a tame pigeon. It is not unusual amongst raptors for young juveniles to chase larger prey items before they gain sufficient experience (Sherrod 1983, pers. obs.).

During the breeding cycle Moller (1989) recorded mainly cliff dwelling birds as prey. However, he also recorded a significant number of seed-eaters such as weavers (*Ploceus* sp.) which in this study comprised 33.3% of the prey. Food caching by Taita Falcons has been reported by Dowsett (1983) and Moller (1989) and it has been explained for falcons in general by Cade (1982) and Gleason and Bolland (1991).

Only the "kree kree" vocalization of the small chicks (Dowsett 1983) and the aggressive "kekking" (Colebrook-Robjent 1977) calls have been recorded before. Vocalizations are very similar to the Peregrine Falcon



(Cade 1982, pers. obs.) and we agree with Cade's statement: "There seems to be an exact homolog for each of the peregrine's calls, and I take this fact as strong evidence of close phylogenetic affinity between the two species."

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